Amendments to the Specification:

Please replace paragraph "BACKGROUND OF THE INVENTION" with the following amended paragraph:

BACKGROUND OF THE INVENTION

When the over current ranging from several ten times to several hundreds times of the rating enters into a fuse link, the over current is interrupted after fuse element partially melted. On this moment, arc discharge starts between the remained elements.

When this remained element melts progressively by the arc's heat, the discharge gap becomes wider and the arc is extinguished spontaneously.

If the source of electricity is AC, the arc tends to extinguish easily at the moment when AC voltage becomes to zero.

It is well known the filling material like quartz sand is ~~so~~ filled in the fuse body ~~as~~ to cool the metal vapor derived from element metal and also to condense it on the surface of the sand.

~~There however, exist harder cases to extinguish the arc discharge.~~

However, in some cases extinguishing the arc discharge becomes harder.

When the fuse link is shorter, it is harder to extinguish the arcing discharge, because the total gap between both terminals is originally short.

~~While the fuselink for higher voltage use, arcing discharge is also hard to be extinguished.~~

On the other hand, for the fuse link used for higher voltage, arcing discharge is also hard to extinguish.

In addition to above, for the DC voltage source that does not cross zero volt, there is less chance ~~of extinguishing the arc~~ that the arc is extinguished spontaneously.

For these cases filled sand does not work enough alone and finally very long fuse have to be applied, that is practically inconvenient for the compact electrical equipments.

This invention relates to applying a short fuse to higher voltage including DC source ~~in a short fuse~~. ~~When~~ As long as arc continues, fuse element continues evaporation that supplies metallic vapor, and elevated vapor pressure bursts the fuse body or blow off the terminal caps.

Arc ~~heating~~ heat results not only internal ignition of fuse body, but also the external flashover ~~between~~ within the fuse holders and finally damages the equipment where the fuse link is installed. The damage may result enormous.

Please replace paragraph "THE SUMMARY OF THE INVENTION" with the following amended paragraph:

THE SUMMARY OF THE INVENTION

This invention solves the ~~requirements~~ problems ~~for~~ that may caused in ~~the~~ following cases:
In ~~the~~ case No. one that the voltage between the terminals of fuse is high enough, in ~~the~~ case No. two that the entering current is also high compared to the rating, in ~~the~~ case No. three that the fuse length becomes shorter than before, to catch up the miniaturization of electric and electronic components, or in ~~the~~ case No. four that the source is high current DC.
For these cases any conventional fuse withal filler material does not work reliably.
~~For~~ By this reason this invention relates an enhancing the breaking capacity of the fuse by ~~making~~ means of a surer arc extinguish mechanism ~~more surely~~ .

A particular object of the invention is to take advantage of the shock wave generated by a sudden evaporation of the fuse element by means of reflecting and converging it ~~at~~ on the internal concave wall or polyhedral inside concave wall of the fuse body of the fuse's enclosure and also having the shock wave converge on the arc itself, so as to boost the atmospheric pressure around the arc, which leads to extinguish the arc.

Please replace paragraph "DETAILED DESCRIPTION OF THE INVENTION" with the following amended paragraph:

DETAILED DESCRIPTION OF THE INVENTION

The individual steps of arc breaking are analytically mentioned in due course.

1) In the first place, general sequence of the arc behavior is as follows when over current entered into a fuse link. (Fig.1) (Reference 1)
At first the current rises at the period "a", when the over current enters.
In this period "a" the fuse voltage between ~~the~~ both terminals is still low because

element is not melted yet and the voltage slightly rises corresponding to the rise of the current.

At the end of this period "a" fuse link's voltage suddenly jumps up after element melt down.

This voltage jump-up is confirmed between ~~the~~ both terminals ~~and~~ by the voltage rise ~~is~~ caused by the change of conductance of the circuit.

Usually arc discharge starts at the very end of period "a", while up to this point only 40% of the total element is vaporized. (Ref.1)

When the arcing continues beyond this point and becomes persistent enough until 1/4 cycle of AC where AC voltage closes again to cross zero shown in Fig.1, the fuse link is mostly damaged.

Therefore it is strongly requested that arc discharge ~~may~~ shall be terminated as soon as possible after period "a" of Fig.1.

2) In the next place, present invention proceeds further as follows:

The arc discharge which overrun the end of period "a" causes a sudden evaporation of the element at the middle of it, because after "a" the current goes stronger and voltage goes higher, then the generated arc heat is consequently high enough to melt the remainder of the element explosively.

This sudden gas expansion generates the shock wave. (Ref. 2)

3) This shock wave goes forward in the fuse body and reflects nearly optically at inner wall of fuse body.

This inner wall is so prepared as to form concave mirror, --this is the core of the invention—then the shock wave converges at the focus of the concave mirror.

Fig.2 (Ref.3)

The wall shown in Fig.2 has the paraboloidal concave, and other concave which forms the focus as the ellipsoidal concave or a hyperboloidal concave is also applicable for this purpose, corresponding to the characteristics of the fuselink's configuration.

It is reported that strictly speaking ~~diverging~~ converging the shock wave is not ruled by the optical focusing but by the aerodynamic focusing which shifts the focus point closer to the reflection wall. (Ref.3)

It however confirmed the optical focus may practically substitute for the aerodynamic one.

4) Around the point or the axis where shockwave focused on, the shock wave's diameter is infinitely condensed to zero, while the shock wave's energy is mostly maintained.
Then the shock wave's energy density extraordinarily increases. And as the result the medium's transferring speed, medium's pressure and medium's temperature are elevated keenly.
Especially increase ratio of medium's pressure at the focus area reaches to 2.3 ~ 3 times of the original pressure independently of Mach number of entered shock wave. (Ref.3) Fig.3

5) As to the necessary factors for arc-extinction, the atmospheric pressure is as important as the cooling of the arc. This local increase of the pressure acts as the arc-extinction.

References

1: A.Wright & P.G.Newbery (1984) Electric Fuses, IEE, Power Engineering Series 2, p.38
2:Kazuki Takayama (1998) Shock wave, published by OHMSHA, p.72
3:Kazuki Takayama (1998) Shock wave Handbook, published by Spüringer Verlag Tokyo p.81~96
4:Ionization phenomena in Gases (1969) Edited by Denki Gakkai, published by OHMSHA p.199~210

Please replace paragraph "BRIEF DESCRIPTION OF THE DRAWINGS" with the following amended paragraph:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is the explanatory drawing of the arc behavior at the point of current interruption when short circuit occurred. (Referred from reference 1)

Fig.2 is the explanatory drawing, which shows the reflection and convergence of the shock wave at the concave wall. (Referred from reference 2)

Fig.3 is the explanatory drawing, which shows the atmospheric pressure rises at the focused point of the shock wave. (Referred from reference 3)

Fig.4 shows the first preferred embodiment of this invention by its cross section.

Fig.5 shows explanatory drawing of mechanism of the invention.

Fig.6 shows the first preferred embodiment of this invention, which is especially applied for the small sized fuses.

Fig.7 shows explanatory drawing of mechanism of the invention especially containing the polyhedral concave wall.

Fig.8 shows the another example of first preferred embodiment of this invention, which especially contains polyhedral concave wall. This is also preferably applied for the small sized fuses.

Fig.9 shows the second preferred embodiment of this invention.
Fig.10 shows waveforms of the voltage and current during current interruption test of the second preferred embodiment of this invention.

Fig.11 shows waveforms of the voltage and the current during current interruption test of conventional fuse. (for comparing to the fuse of the invention)

Reference numerals

1 Electric insulator
2 Electric conductors
3 Fuse element (initial stage of arcing)
4 Fuse element
5 Concave walls for reflection
6-a, 6-b Convergent focus of the shock wave
7 Filled sand grain
8 Solder
9 Point of arc initiation

Please replace paragraph "DESCRIPTION OF THE FIRST PREFERRED EMBODIMENT" with the following amended paragraph:

DESCRIPTION OF THE FIRST PREFERRED EMBODIMENT

Fig.5 and Fig.6 show~~s~~ a fuse link of which reflection wall for shock wave has two ellipsoidal concaves, while Fig.7 and Fig.8 show also a fuse link of which reflection wall has two ellipsoidally segmented polyhedral concave walls 5. Ellipsoidally segmented polyhedral concave wall can be regarded as ellipsoidal concaves wall hereinafter, because the arc extinction mechanism of both are similar.

The electric insulator 1 in which contains these concave is composed of two halves of length-wisely sliced body to be adhesively assembled into one body. In an assembled ~~Electrical insulation~~ body **1**,~~consists of~~ two ellipsoidal concaves **5** ~~which~~ partially ~~overlapped~~ superimposed each other, i.e. two ellipsoidal concaves **5** are so arranged as to place one of the focuses ~~is placed~~ on the midway of the element ~~3~~ **4** respectively.

Two electric conductors **2** are attached at the both ends of the body. Fuse element **4** is spanned between two electric conductors **2** and fixed with solder **8**.

Under the normal conditions the element starts arcing at **9** the midway point of the element **2**. The shock wave generated there reflects on the of concave wall **5** and converges at the focuses **6-a** and **6-b**.

The arc extinction mentioned above is subsequently happened by the focused shock wave.

The arrows show the path route of the shock wave in Fig.5 and Fig.7. This action is caused within both ellipsoidal spaces.

This type of body construction is more applicable to the short fuse, especially classified as micro fuse, the longitudinal dimension of which is not so long for the diameter.

Please replace paragraph "DESCRIPTION OF THE SECOND PREFERRED EMBODIMENT" with the following amended paragraph:

DESCRIPTION OF THE SECOND PREFERRED EMBODIMENT

In a fuse (Fig. ~~7~~ 9) which has relatively longer body comparing to the cross section, the shock wave generated by spot explosion of the arc becomes flat shock wave while it is passing through the long insulation body. (Reference 3)
The paraboloidal reflection wall is adopted on both ends of the body so as to converge this flat shock wave. In this preferred embodiment the terminals **2** has internal concave wall to converge and reflect the shock wave at the focus point **6-a** and **6-b**.
As to the selection of concave: Depending on the body length hyperbolic concave wall may be chosen.
As to the setting of curvature's radius: Depending on the breaking characteristics of the fuse, focus point shall be altered, and then the curvature's radius shall be given by the focus point.
In this embodiment the fuse is filled with filler material like granular quartz **7**.
Waveforms of second embodiment are shown in Fig.-~~8~~ 10 comparing to that of the conventional sand filled fuse. (Fig.-~~9~~ 11)

The arcing time in the current waveform is highly shortened until 0.5 millisecond. This arc suppression decreases heat generation of the arc and subsequently the insulation body and terminal ~~caps~~ ferrules are kept from any damage.

Table 1 shows the summery of breaking capacity test on the embodiment 2. For the ~~case~~ result that any explosion of the body or damage of terminal is not perceived, table counts successful interruption.
This table has confirmed the utilization of shock wave in the breaking test.

Amendments to the Claims

[1] The listing of claims will replace all prior versions of claims in the application.
Since the prior versions of claim included

a) improper definitions of process (35U.S.C.112) and

b) missing of setting forth any steps involved in the process(35U.S.C.112)

which were pointed out by the Office Action, the current version was so revised as to correct them by the reconstruction of what have been stated in prior application without adding any new matter :

Claim 1 (currently amended)

Claim 2 (currently amended)

[2]Regarding to the reason for claim rejections 35U.S.C.102, please let me quote the **Remarks and Arguments** mentioned in page 18 −22.

Prior claims

CLAIMS

~~1 Method of avoiding arc prolongation while interrupting the current, using the shock wave generated by the arc discharge, including the internal concave wall of the body, comprising paraboloidal concave wall, spheroidal concave wall, hyperboloidal concave wall or other concave walls and polyhedral walls which converge and reflect the shock wave onto the prolonged arc point.~~

~~2 Method of forming a cartridge current fuse, comprising conductors, fusible element which is electrically connected to conductors, and nonconductive body wherein inner wall of the conductors or/and fuse body forms the concave which converge and reflect the shock wave generated by the arc discharge to make the focus onto the prolonged arc.~~